

Hadron Monitor Test Stand Controller – Raspberry Pi based CNC System

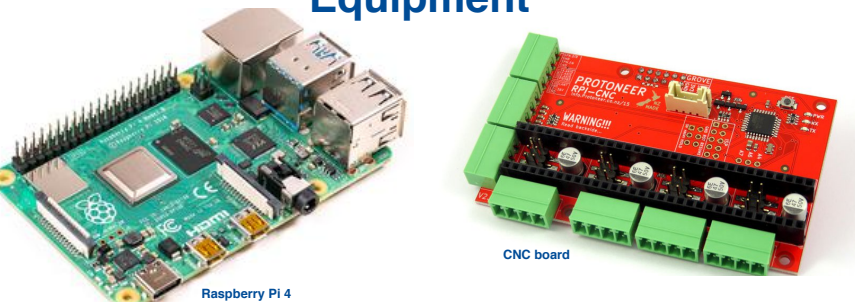
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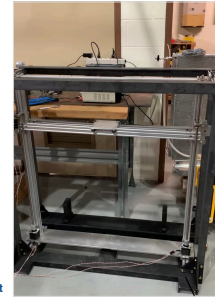
Background and Project mission

The hadron monitor is a key beam diagnostic to guarantee a quality neutrino beam. The current hadron monitor is exposed to intense levels of radiation and the output signal degrades in this environment and over time. Our goal is to improve the response of the hadron monitor using a Raspberry Pi based CNC (Computer Numerical Control) system, a program controller that will manage a motor driver, a position sensor, and an output signal from a pixel.

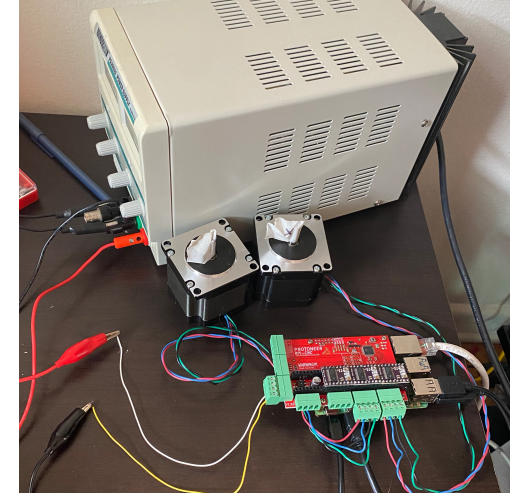
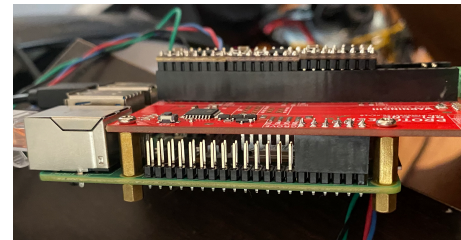
Equipment



Hadron Monitor Test Stand Layout



Motor Controller Assembly



The raspberry pi is a small computer with 2 HDMI ports, a micro USB-C port for the powering, an ethernet connection port, a set of USB 2 and USB 3 ports. The CNC is a board with 4 stepper channels X,Y,Z and A that can be mounted on the Raspberry Pi. The two systems form a powerful ecosystem where the raspberry Pi provides strong WIFI connectivity and processing power and is supported by an established user community.

The assembly design is comprised of a Raspberry Pi 4, a CNC board that is mounted to the Raspberry pi with 4 copper spacers (M 2.5*11mm), a DC power supply that is set at 18 volts, two NEMA 23 stepper motors (X, Y) wired to the CNC board through adapters and motor drivers. The wiring for the stepper motors are accomplished through the phases of the wire. In this case, phase A corresponds to red and blue and phase B corresponds to black and green. The current voltage of the motor drivers is set at 1.2, and this can be set by rotating the reference voltage of the motor drivers on top of the CNC board.

How the commands are sent ?

GBRL CNC command sender, auto leveler and g-code editor, the BCNC is a cross platform program written in python; a fast and robust communication platform compatible with the Raspberry Pi. The motors are run by the control commands. The rotation speed of both motors are controlled through the BCNC by command such as $\$J=X\% Y\% Z\% F100$ that is entered in the terminal and where the % symbol is a coordinate point and F represents the feed. This command can be used with all the axes at the same time, or with only one.

Summary

The beam monitor itself is not yet complete, however, the first part of the project, designing, building, and programming a controller for the monitor has been successfully executed and tested on the motion table. The Raspberry Pi based CNC Control System is finished and ready to use with the new hadron monitor.

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